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The Taptana Cañari as a Didactic Resource to Promote Solidarity in the Teaching of Mathematics

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Abstract

The objective of this study was to design a strategy that uses the Taptana cañari as a didactic resource to promote solidarity in the teaching of mathematics. The research approach was qualitative, in the sociocritical paradigm, through a case study. As a method, investigative techniques were used: observation in the workshops, interviews with teachers, and expert judgment to analyze the photographs taken during the workshops. Based on the theoretical categories of solidarity: social responsibility, respect for identity, emotional intelligence, and teamwork, the instruments were developed: an observation guide, an interview guide, and the observation sheet used by the experts. Among the main results, it can be noted that the use of the Taptana cañari as a didactic tool generated interest in ancestral knowledge and facilitated the learning of mathematics, which promoted the development of solidarity as a human and social value.

Keywords: *Core Values, Didactic Resource, Education, Mathematics, Solidarity, Taptana Cañari*

INTRODUCTION

The Ministry of Education of Ecuador (MinEduc, 2016), in the Curriculum for Compulsory Education Levels, establishes that the graduation profile of the Ecuadorian high school graduate is based on the values of justice, solidarity, and innovation, along with the competencies and responsibilities that students should develop throughout their student life. This profile highlights the interest of the Ecuadorian education system in developing teaching processes that promote the formation of civic values. In addition, the curriculum gives great importance to the knowledge of the ancestors and the dialogue of knowledge (Ananda et al., 2022). At the same time, it states that interculturality is a transversal factor that should be considered in all processes. However, teachers are threatened by the challenge of educating their students integrally, combining knowledge and values through an innovative pedagogical practice that is not specified in the curriculum.

Díaz Quezada & Letelier (2013) point out that the inclusion of the so-called Transversal Fundamental Objectives (OFT) in all areas of the curriculum favors the training of students to rationally and autonomously construct their value system so that they can critically evaluate the reality around them and actively intervene to achieve its improvement. Therefore, the use of concrete material to teach mathematics can favor the development of ethical values such as justice and solidarity. Consequently, the general objective of this study is to design a strategy that uses the Taptana cañari as a didactic resource to promote solidarity in the teaching of mathematics.

LITERATURE REVIEW

In this sense, it builds on previous studies that have shown that the use of tangible materials stimulates students' interest (González, 2010), while contributing to their empowerment in addressing issues of identity (Vargas, 2014). Consequently, Taptana cañari can contribute to the active construction of knowledge while creating an

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ideal space for teachers to work on values, especially those of multiculturalism and solidarity based on individual differences. In addition, Bernstein (1987) points out that,

The school must become a community of life and education must be conceived as a continuous reconstruction of experience. community of democratic life and reconstruction of the experience based on dialogue, contrast, and real respect for individual differences, on whose acceptance mutual understanding, agreement, and solidarity projects can be based. What matters is not uniformity, but the discourse (p.47).

However, to achieve this reconstruction indicated by Bernstein, schools must promote the development of human values. Mutual respect, solidarity, and common interests through the content of different fields of knowledge can be approached interdisciplinarily as part of the knowledge that people need to make a full and democratic life possible (Herliah et al., 2022).

Now, mathematics as a discipline is essential for the intellectual development of children because it contributes to orderly and logical reasoning, as well as to the projection of the mind for analysis, reflection, and abstraction (Morales, 2019). For this reason, mathematics should be the main field of knowledge that seeks to train children and adolescents in values for conscious and favorable decision-making, which allows them to take actions that lead them to find solutions to the problems they face in daily life. In addition, mathematics allows students to build patterns to guide them through a lifestyle and to face reality rationally and appropriately (Theodorou et al., 2021; Salinas et al., 2013).

In this sequence of ideas, MinEduc (2016) suggests that values should be formed from the national identity framed in a safe and peaceful world that values multiculturalism and respects the identity of others. On the other hand, Medina & Rodrigo (2005) state that the proposals to build a "solidarity" from cultural pluralism presuppose a transformation in the way of perceiving the world, based on the certainty of the potentialities of each person. In other words, education is called to go through models based on the cultural and discursive patterns of ethnic groups, to support more consistently the development of basic cognitive skills and the formation of ethical values (Elledge et al., 2018).

In the current curriculum of Ecuador, multiculturalism is linked to solidarity. This is clearly expressed because it establishes that the value of solidarity must be expressed in the recognition and respect of minorities (MinEduc, 2016). In this virtue, it becomes necessary that intercultural relations are based on respect for plurality and mutual richness. However, it must be recognized that this is not a process that is developed without dilemmas. However, these disagreements can be resolved by respecting differences, organizing a horizontal context for effective communication, strengthening dialogue and active listening in both directions, achieving equitable and relevant access to relevant information, and seeking pacts and partnerships. In this scenario, ancestral knowledge can guide teachers to generate development alternatives in the various human processes through education, for which well-developed scientific research will be the tool that makes it possible to achieve this goal. For this reason, it is necessary to study concepts such as the Taptana Cañari, an element developed by the Cañaris Indians 3,500 years ago, to develop pedagogical proposals that improve the educational process through the formation of values such as solidarity (Calderhead, 1989; Korthagenet al., 2006).

According to Gheverghese (1996), mathematics has emerged in different latitudes as a set of concepts produced by people in response to the needs of their context. Proof of this is that in southern Ecuador, specifically in Narrio (a community near the city of Cañar), which belongs to the area inhabited by the ancient Cañaris, the archaeologist Donald Collier discovered an object called the Taptana Cañari. This object was found in the epistemological field of Andean philosophy, where knowledge is holistic, contrary to Western concepts that propose a scientific division that has given rise to different branches of knowledge.

At this point, it should be noted that the historian Cordero (1984) discovered the algorithms that showed that this object allowed its creators to perform arithmetic calculations. Later, his work was perfected and made known by Professor Luis Montaluisa in 2007, who came to design a taptana that makes it clear that this artifact was used as a calculator by its creators, the Cañaris. It should be noted that the taptanas found have been carved in stone or wood and have unique characteristics such as a larger cavity considered the most relevant part of the object, in addition, it has some columns shaped like snakes formed by nine smaller cavities, easily

recognizable that are concentrated in such a way that they do not allow any misrepresentation (Vásquez & Duchi, 2021).

In this sense, it should be noted that, according to Vásquez and Duchi (2021), certain guidelines must be followed to work with the Taptana. Among them, that the Taptana is based on the base ten notation, that the largest cavity is related to the conceptualization of zero, not in the sense of the absence of quantity, but as the link that allows the change of an order to its immediate higher one. In other words, this void is the means to go from units to tens, from tens to hundreds, and others in the same direction. Similarly, tokens or grains can be in the larger cavity only temporarily, and grains or fish can represent only one numerical order. In addition, it must be fulfilled that the snakes or leoquinas facilitate the representation of the units, tens, hundreds, and units of a thousand, to constitute the order of the cards used, which must be located from the outside inward, that is, toward the cavity. higher, and finally, if there are no tokens or grains in a leokine, it means that this order would have zero elements (Vásquez & Duchi, 2021). From this, with the taptana cañari you can develop different operations such as counting, addition, subtraction, multiplication, and division.

METHODOLOGY

This work is based on the socio-critical paradigm, because Popkewitz (1988), as precepts of this model, proposes to perceive and understand reality from practice unified with theory, integrating values, actions, and knowledge to involve all research participants, including the researcher, in self-reflective processes to make joint decisions. In this way, it is possible to use the Taptana cañari as a didactic resource that allows the promotion of solidarity as a fundamental value in the training of students in the Ecuadorian educational system.

To develop this research, a qualitative approach was proposed, based on a case study, since this type of study allows us to observe group behavior adapted to its context, to understand the speaker and his understanding of reality, to combine their perceptions, and to allow assimilation and interpretation studies sponsored by experienced subjects (Stake, 1998). In this way, an urban educational unit in the city of Azogues was chosen as a case study because the director showed a clear interest in developing workshops in this institution, which is always open to innovative processes in education and is a benchmark in basic education in the province and the country. Thus, we worked with the two parallels of the fourth year of basic education at the institution, so that 44 boys and 36 girls aged between 8 and 9 years participated in the workshops. Two teachers also participated, one from each classroom of the fourth year of primary school, and four teachers who played the role of experts.

Given that this work has used the Taptana as a didactic tool that allows integration values in the teaching of mathematics, it is also emphasized that the case study provides both students and teachers the opportunity to examine the results of this experience in the compilation of information on the various responses that have emerged from the execution of the proposed workshops. Therefore, the workshops were held for an hour and a half in the morning and another hour and a half in the afternoon over 4 days in February. It was applied as a research method: participant observation during the execution of the workshops, the interview with the teachers after the execution of the workshops, and the judgment of experts to analyze the photographs taken during the workshops (Tambychik & Meerah, 2010; Friso-Van den Bos et al., 2013).

Participant observation was used because it allows the researcher, as an observer, to be part of the research and not a subject at a distance from the process and the reality being analyzed, to obtain information from within the phenomenon being studied (Díaz, 2011). In this sense, the participant observation allowed the researchers to obtain information about the use of the Taptana cañari as a resource for teaching mathematics, from the context where the research participants develop, that is, in their classroom in the educational unit during the implementation of the workshops, to understand if these workshops fulfilled the objective. Similarly, interviews were applied to classroom teachers to know their perceptions regarding how practices or aspects related to the theoretical categories of solidarity proposed in this research were developed in the workshops. According to Vargas-Jiménez (2012), the interview as a technique allows to know the informants' perception of a certain phenomenon in detail and from their perspective, which allowed the researchers of this work to have a different

point of view from theirs regarding the workshops that were applied, in which the Taptana was used as a didactic resource.

In order to design the information collection instruments, the concept of solidarity was taken as a starting point, which, according to the literature review carried out, can be analyzed from four theoretical categories: "social responsibility, respect for identity, emotional intelligence and teamwork" (Vasquez, 2021). Therefore, the instruments designed and applied in this research were the following: workshop observation guide, interview guide addressed to the teachers of the fourth year of basic parallels in which the workshops were implemented, and the directed observation sheet. to external experts (Prykhodko et al., 2022). On the one hand, the observation guide was designed with 4 items based on the identified theoretical categories, to which there were spaces to record observations and a final space to record any comments that the observer might have. On the other hand, the interview guide was designed with 14 questions distributed as follows: two questions in the category of social responsibility, four questions in the category of respect for identity, five questions on emotional intelligence, two items on teamwork, and a general question on teachers' perception of the Taptana cañari workshops and their impact on students (Zengin et al., 2012; Yamagishi & Mifune, 2009). In the same logic, the observation sheet addressed to the external experts who analyzed the photographs was designed with two questions that sought to know the experts' perception of the students' attitudes, emotions, and values practice during the implementation of the workshops. always directed towards the promotion of solidarity (Merz et al., 2007).

RESULT AND FINDINGS

It was possible to collect the results of eight completed observation guides, two interview guides with the perceptions of the teachers, and four guides with the opinions of the experts. Consequently, to analyze the information collected, the NVivo software was used, which made it possible to transcribe the interviews and then create codes based on the theoretical categories and the categories that emerged during the research. The same software was used to analyze the information from the observation guides. However, for the analysis of the photographs, expert judgment was first applied and then these results were compared with those obtained from the interviews and the observation guides. Subsequently, using the same tool, the following graphs were created, which were analyzed and interpreted in order to obtain reliable results for the research. Table 1 shows the results of the observation guide.

Table 1: Results of the observation guides

Sessions	Results of the observation guides
First session	Familiarization with the Taptana cañari
	Organization of groups
	Generation of a pleasant environment to work
Second session	The artistic creativity of the students
	Students value ancestral knowledge
	Generation of collaborative environments
Third session	Commitment and responsibility of students
	Compliance with the proposed activities
	Compliance with the curriculum
Fourth session	Compliance with the proposed activities
	Introduction of narratives of the place
	Compliance with the curriculum
Fifth session	Assimilation of the algorithms of the Taptana cañari
	Construction and problem-solving Completion of
	the curriculum
Sixth session	The students with different abilities allowed the cards to be placed in the taptana with the guidance of their classmates
	The participants enjoy the cooperative work
	The children f They were very creative, cordial and participative

Seventh session	Active and dynamic participation of the children
	The children encouraged their classmates with different abilities
	The children are more supportive of the active participation of the group
Eighth session	The children harmonize in the work and do it as a team
	The students assimilated the mathematical processes with enthusiasm
	In the groups, everyone participated in the different activities

According to the Ministry of Education (MinEduc, 2016), "the mathematics curriculum promotes ethical values, dignity and solidarity, and the strengthening of a sociocultural" (p.82). Therefore, the use of the Taptana cañari as a didactic tool for the teaching of mathematics during the development of the workshops allowed the creation of an environment in which the activities were carried out in a warm and supportive manner, with respect, support, collaboration, joy. and other values such as solidarity. Therefore, what is indicated by the Ministry of Education confirms what was concluded in this study.

It is important to emphasize that the presence of a student with different abilities in the classroom aroused an attitude of solidarity in his classmates, in the sense that the proposed activity was adapted by his classmates so that their participation is active. This confirms what was stated by Juárez Núñez et al. (2010), who points out that "school must be the privileged space where we all learn to live with others and where everyone has the opportunity to develop their learning capacities to the maximum" (p.46). Consequently, it was found that the development of the workshop activities created an environment of respect, camaraderie, and cooperation, which in turn changed the attitudes of all the participants.

The technique of expert judgment was used to analyze the photographs taken during the workshops because, according to Escobar-Pérez & Cuervo-Martínez (2008), "an informed opinion of people who have experience in the subject, who are recognized by others as qualified experts in it, and who can provide information, evidence, judgments, and evaluations" (p.29) can validate the reliability of a study and the products or information collected in it. Among the criteria for the selection of the experts, it was considered that they had training in basic education, at least ten years of experience in teaching at this level of education and that they had publications related to the teaching of mathematics, so that when observing the photographs they could provide a valid and scientific judgment based on the observation of the attitudes and emotions shown in the photographs. Table 2 shows the experts' judgments of the photographs.

Table 2: Judgment of experts regarding the photographs

Category	Expert 1	Expert 2	Expert 3	Expert 4
Social responsibility	Interaction with heterogeneous groups	Comprehension	Empathy	Tolerance
Respect for Identity	Action for a Peaceful World	Acceptance of multiculturalism	Positive assessment of multiculturalism and multiethnicity	Respect for the identities of other people
Emotional intelligence	Be positive	Be flexible	Be cordial	Be supportive
Teamwork	Understand the surrounding reality	Respect the ideas of other people	Show solidarity toward colleagues	Respect the contributions of other people

Figure 1 shows the analysis carried out by interviewee 1, where you can see the impact, it had on the students and the perception of the Taptana cañari workshops.

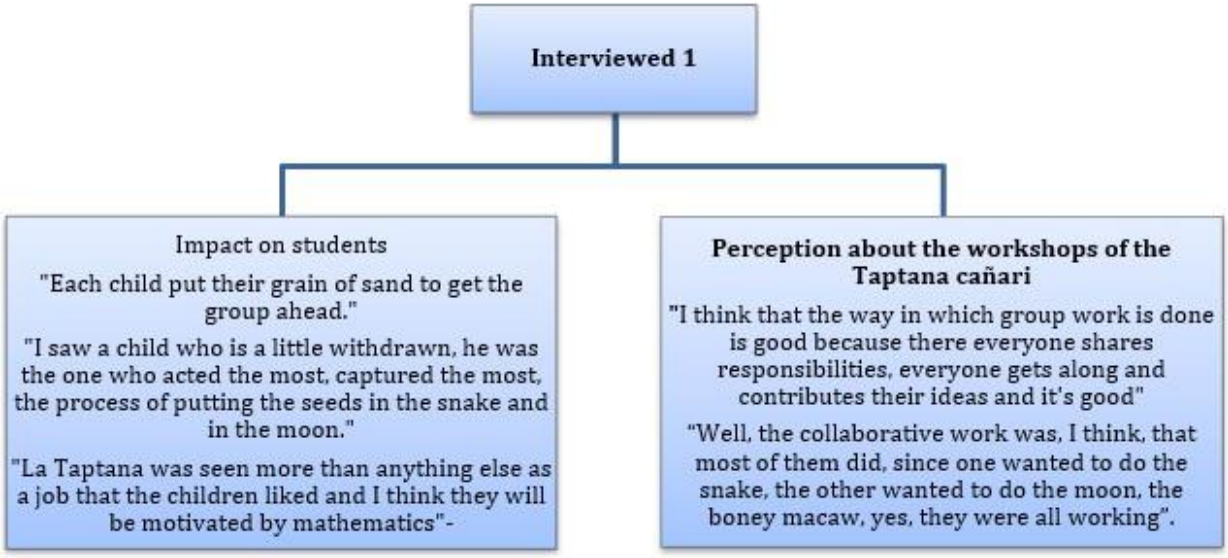

Figure 1. Answers from Interviewee 1

Figure 2 shows the result of interviewee 2, where the impact on the students and the perception of the workshops are observed.

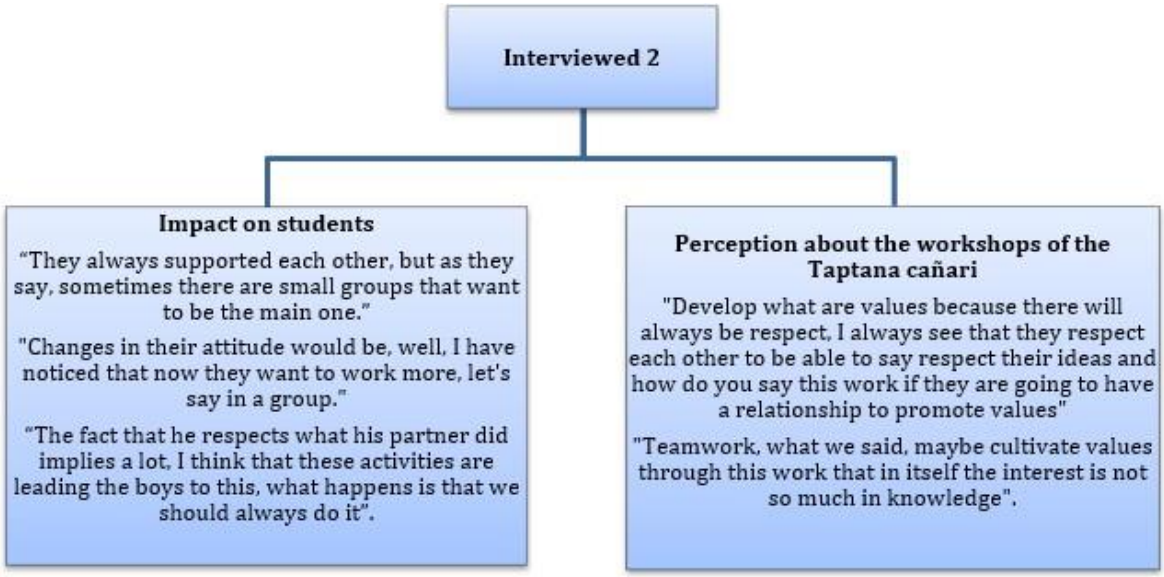

Figure 2. Answers from the interviewee 2.

The workshops generate interest, facilitate the process of teaching mathematics, and encourage student participation. This is a part of cohesion, an awareness of ancestral knowledge, and an aspect that strengthens identity. This is in line with what is indicated by the Ministry of Education (2016), which indicates that to develop the value of solidarity, it is necessary to build the national identity peacefully, valuing multiculturalism and multiethnicity, with respect for the identities of others. In addition, an environment of greater participation and trust has been developed, with characteristics more in line with the so-called New School, which in turn creates an ideal space for promoting the value of solidarity. Consequently, the importance of the results obtained is demonstrated, since they show that the workshops carried out made it possible to achieve the proposed research objectives.

Bishop (2000) argues, although this is not a generalization, that when teachers strive to develop mathematical content most effectively so that their students can assimilate it, solidarity is fostered, as is the case when classmates who understand a concept better support others to assimilate that concept as well. An idea that agrees with what was stated by the experts who identified subcategories of social responsibility, empathy, and tolerance as values that contribute to the promotion of solidarity.

It is worth noting that all the experts have observed team or group work and that the records of these experts ensure that collaborative work was carried out, which favors educational innovation. According to Vásquez (2018), educational innovation is not only developed from objects, processes, or methodologies but rather innovation is developed from the attitude of teachers. Therefore, of the four categories established for the value of solidarity, these were observable in the photographic records created in the workshops that were developed. It should also be noted that the group of experts has made it clear that the behavior of the participating students indicates the practice and development of the value of solidarity.

Educational innovation does not necessarily mean that new methods or resources are proposed or created, but that small changes are generated that help teachers and students build knowledge using existing resources, regardless of the situation. Therefore, the Taptana cañari, as a teaching tool, fulfills the dimensions that characterize educational innovation. That is, it generates perceptions of improvement among the actors in the educational process by using it effectively and efficiently, democratizing the classroom with a social sense of knowledge, and being innovative in the context.

It could be pointed out that in future research it would be beneficial to carry out the workshops in a school with rural jurisdiction, to obtain information on the development of solidarity as a fundamental value in this context, using the Taptana cañari as a didactic resource. In the same way, in addition to the intercultural elements, transversal and interdisciplinary processes could be worked on, which would allow for a holistic integration of the students.

CONCLUSION

The use of Taptana cañari as a didactic resource has generated interest in ancestral knowledge and has facilitated the learning of mathematics, as well as holistic learning that promotes the development of solidarity as a human value. In addition, the workshops allowed the students to develop the activities in their context, with their possibilities and limitations, which led them to their construction of knowledge and development of values, favoring the appropriation and assimilation of content. In short, solidarity becomes a means to achieve learning outcomes, in addition, the practice shows the importance of cultivating this value to achieve positive results in life.

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